THE OHIO STATE UNIVERSITY/ DEPARTMENT OF ENTOMOLOGY

Revision of Diagnostic Morphological Traits in Four Caribbean Species of *Heterotermes* (Isoptera: Rhinotermitidae)

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OBJECTIVES

To determine robust diagnostic morphological characters of four Caribbean termite species in the genus *Heterotermes* (*H. cardini*, *H. convexinotatus, H. tenuis*, and *H.* sp.), with genetic information enabling assessment of the utility of four pronotal indices as specific identifiers.

INTRODUCTION

The termite genus *Heterotermes* Froggatt, 1897 is a pantropical genus of subterranean wood feeders. It is one of three economically important genera in the family Rhinotermitidae. These pest termites inflict structural damage by excavating galleries in wooden architectural components. Despite their economic significance, the taxonomy of *Heterotermes* remains understudied, particularly for the West Indies fauna. This is attributable to a lack of robust morphological characters in species identification (Snyder 1924; Szalanski et al. 2004).

MATERIALS AND METHODS

- All samples originated on the Puerto Rican mainland or on the neighboring island of Culebra.
- All collections were assigned to *Heterotermes cardini*, *H. convexinotatus*, *H. tenuis,* or *Heterotermes* sp. (Fig. 1).

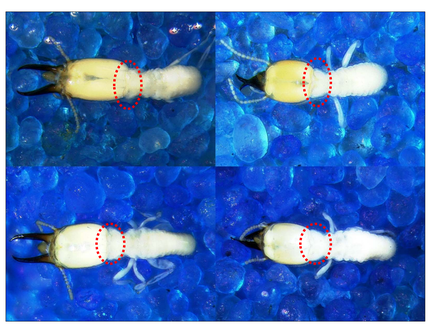

Fig. 1. Clockwise from top left: *Heterotermes* sp.; *H. tenuis*; *H. cardini*; and *H. convexinotatus*. Pronotum on each soldier termite circled.

- Species assignments were made on the basis of a phylogenetic tree of 60 samples from across the Caribbean. This cladogram was concatenated from three genes (16S RNA, COII, and ITS region) by TDE and SCJ.
- Phylogenetic tree revealed that *H. cardini* and *Heterotermes* sp. formed two sister clades.
- Only members of the soldier caste were examined; all specimens were imaged and measured using the AutoMontage image-stacking program (Fig. 2).

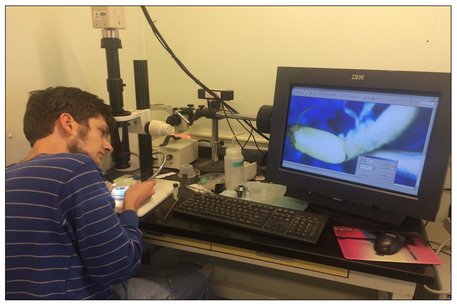

Fig. 2. ZHG operating AutoMontage camera

- Initial measurements were made of four aspects of possible taxonomic utility: the left mandible, postmentum, tibial spurs, and pronotum.
- The pronotum was selected as worthy of further examination (see Fig. 1), with six metrics (Fig. 3) delineated:

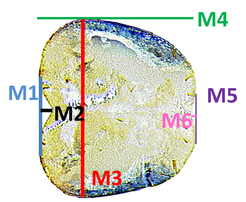

Fig. 3. Metrics delineated on soldier pronotum

- Pronota on 81 soldiers were measured:

Species	No. of colonies	No. of soldiers
H. cardini	**16**	**29**
H. convexinotatus	**16**	**22**
H. tenuis	**1**	**15**
***Heterotermes* sp.**	**6**	**15**

- Four indices (three of them novel in termite systematics) were then derived based on the premise that *H. convexinotatus* and *H. tenuis* are distinct species (Szalanski et al. 2004):

Pronotum ratio (Index I) (Roonwal 1969)	$\frac{length}{width} = \frac{M4}{M3}$
Curvature of anterior pronotal margin (Index II)	$\frac{depth\ of\ anterior\ pronotal\ notch}{distance\ betw.\ anterior\ pronotal\ vertices} = \frac{M2}{M1}$
Curvature of posterior pronotal margin (Index III)	$\frac{depth\ of\ posterior\ pronotal\ notch}{distance\ betw.\ posterior\ pronotal\ vertices} = \frac{M6}{M5}$
Vertex-breadth ratio (Index IV)	$\frac{distance\ betw.\ anterior\ pronotal\ vertices}{width} = \frac{M1}{M3}$

- The statistical significance of these indices were determined using *t*-tests for each species pair.

RESULTS

- Averages of pronotal indices in *Heterotermes* confirmed that *H. convexinotatus* and *H. tenuis* are distinct species (Fig. 4).

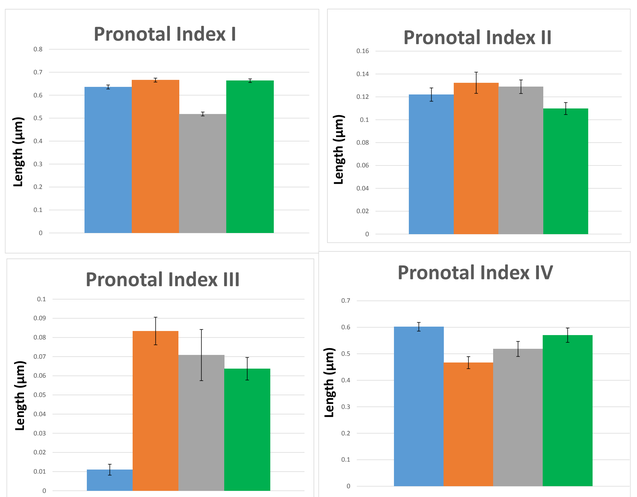

Fig. 4. Blue=*H. tenuis*; orange=*H. convexinotatus*; gray=*Heterotermes* sp.; green=*H. cardini*

- Index II was significantly different between *H. cardini* and *H. convexinotatus* (*P*=0.047), as well as between *H. cardini* and *Heterotermes* sp. (*P*=0.025).
- Index III was significantly different between *H. convexinotatus* and *H. tenuis (P*=0.0002), as well as between *H. convexinotatus* and *H. cardini (P*=0.006).
- Index IV was significantly different between *H. convexinotatus* and *H. tenuis* (*P*=0.00003), as well as between *H. convexinoatatus* and *H. cardini* (*P*=0.0077).
- Index IV was not significantly different between *H. cardini* and *H. tenuis* (*P*=0.313), between *H. cardini* and *Heterotermes* sp. (*P*=0.246), or between *H. convexinotatus* and *Heterotermes* sp. (*P*=0.133).
- Index I was not significantly different between any of the four putative species, but was nearly significantly different between *H. tenuis* and *Heterotermes* sp. (*P*=0.054).

CONCLUSIONS

Three novel pronotal indices (II, III, and IV) allowed significant differentiation among four putative *Heterotermes* species, and therefore were useful for *Heterotermes* species identification. Of these, only Pronotal Index II allowed a distinction between *H. cardini* and *H.* sp. Therefore, all three novel indices were necessary to distinguish among the four species of *Heterotermes* in Puerto Rico.

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